

DESCRIPTION OF THE PUPA OF *Aedes cretinus* EDWARDS, A KEY TO THE PUPAE OF THE *ALBOPICTUS* SUBGROUP, SUBGENUS *STEGOMYIA* THEOBALD, GENUS *Aedes* MEIGEN, AND CHARACTERS TO SEPARATE THE EUROPEAN *STEGOMYIA* SPECIES (DIPTERA: CULICIDAE)

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Abstract.—The description of the unknown pupa of *Aedes cretinus* and a key to the known pupae of the *albopictus* subgroup, *scutellaris* group, subgenus *Stegomyia*, genus *Aedes* are presented. The three species of subgenus *Stegomyia*, genus *Aedes*, which occur in Europe, are characterized.

Key Words: *Aedes cretinus*, pupa, *albopictus* subgroup, European *Stegomyia*

Aedes (Stegomyia) cretinus Edwards, 1921, is the only species of subgenus *Stegomyia* indigenous to Europe. It belongs to Group C of Edwards (1932), the *scutellaris* group. It has been reported from Greece, Georgia (Mattingly 1953), Turkey and Cyprus (Lane 1982). Knight and Hurlbut (1949) divided the group into the *scutellaris*, *albopictus* and *mediopunctatus* subgroups and placed *Ae. cretinus* in the *albopictus* subgroup along with nine other species. Mattingly (1952, 1965) transferred *Ae. grantii* (Theobald) to *scutellaris* subgroup and *Ae. galloisi* Yamada to Edwards Group B which Huang (1972b) reassigned to the *albopictus* subgroup. Moreover, *Aedes (Stegomyia) patriciae* Mattingly, 1954, *Aedes (Stegomyia) seatoi* Huang, 1969, *Aedes (Stegomyia) sibiricus* Danilov and Filippova (1978) and *Aedes (Stegomyia) galloisioides* Liu and Lu (1984) have been added to the *albopictus* subgroup (Huang 1972a, 1979).

The pupae of all species of the *albopictus* subgroup have been described (Huang 1972a, Edwards 1941) except *Ae. sibiricus* and *Ae. galloisioides* and *Ae. cretinus*, which is characterized below. A key for the

identification of known pupae of the subgroup follows. The adult female, male and larva of *Ae. cretinus* were described by Mattingly (1954).

Aedes (Stegomyia) albopictus (Skuse) was first reported in Europe by Adhami and Murati (1987) in Albania, then in Italy in 1990 (Sabatini et al. 1990). It has continued to spread in Europe (Romi 1995) but as yet has not been found in Greece. However, *Ae. cretinus* in Greece has been misidentified as *Ae. albopictus*, causing undue anxiety, fearing a potential for a dengue fever outbreak (A. Samanidou, personal communication, 1997). Indeed the two species are quite similar (Lane 1982) and knowing all of their life stages, including the pupa, will be of benefit.

Three species of subgenus *Stegomyia* presently occur in Europe, *Ae. aegypti* (Linnaeus) (Christophers 1960), *Ae. albopictus* and *Ae. cretinus* (Mattingly 1953). Characters to distinguish the adult females, pupae and larvae are given in Table 2.

MATERIALS AND METHODS

Methods of collecting mosquitoes in the field followed those given by Belkin et al.

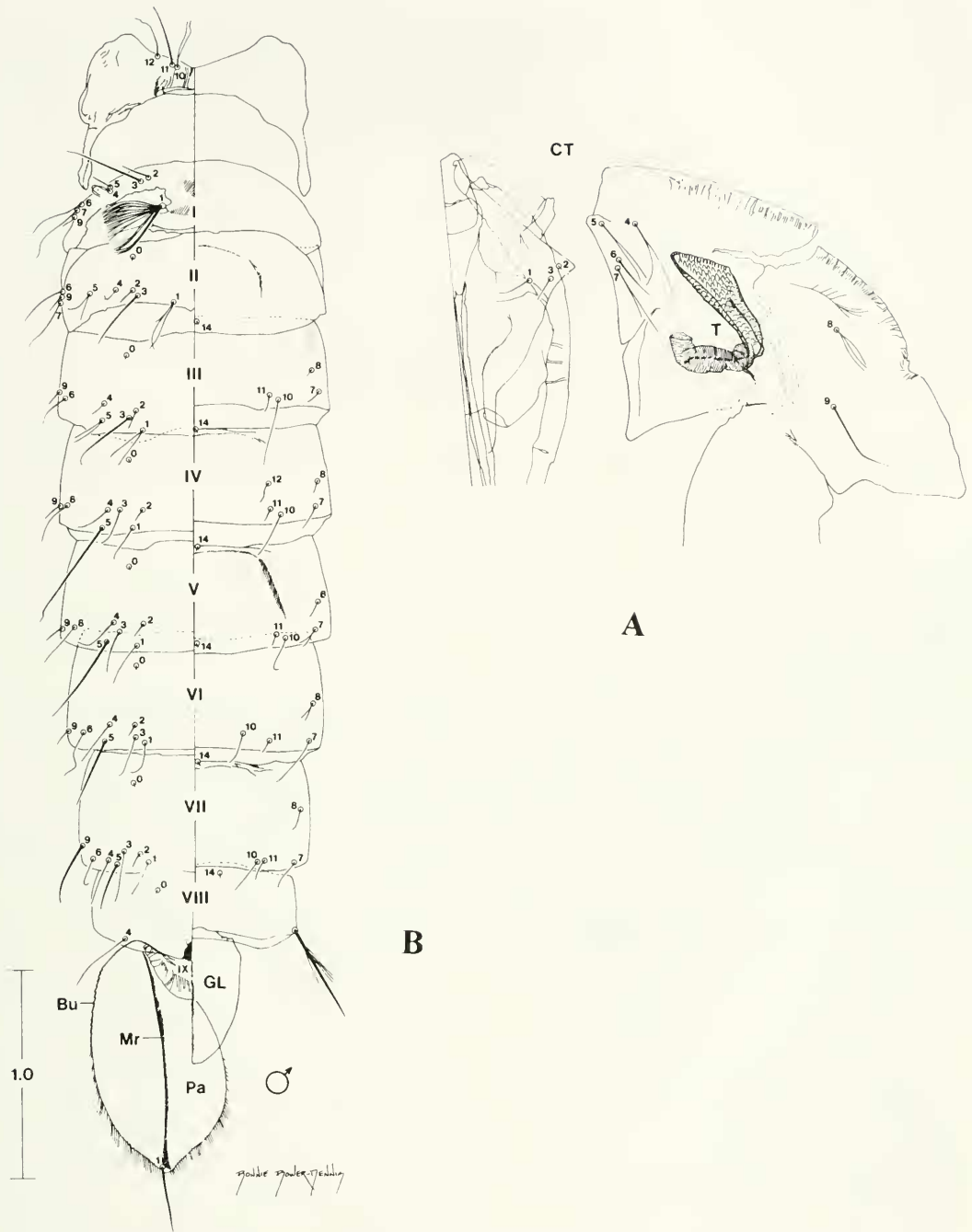


Fig. 1. Pupa of *Aedes cretinus*. A. Cephalothorax. B. Metathorax and abdomen; dorsal-left, ventral-right. Bu = external buttress; CT = cephalothorax; GL = genital lobe; Mr = midrib of paddle; Pa = paddle; T = respiratory trumpet.

Table 1. Pupal chaetotaxy of *Aedes cretinus*.

Seta	Cephalothorax	Abdominal Segments								
		I	II	III	IV	V	VI	VII	VIII	
0	—	—	1	1	1	1	1	1	1	1
1	1	9-13 (11)	2-3 (3)	1-2 (2)	1-2 (1)	1	1	1	1	—
2	1	1	1	1	1	1	1	1	1	—
3	1	1	1	1	1-2 (2)	1	1	1	1	—
4	1-2 (1) ¹	2-4 (2)	1-4 (1)	1-4 (2)	1-2 (1)	1-2 (2)	1	1	1	1
5	1-2 (2)	1-2 (1)	1-3 (2)	1-2 (2)	1	1	1	1	1	—
6	1	1	1	1	1	1	1-2 (1)	1	1	—
7	1-2 (2)	1	1-2 (1)	1-4 (1)	1-2 (1)	1-5 (?)	1	1	1	—
8	1-3 (2)	—	—	1-2 (1)	1	1-2 (1)	2-3 (2)	1-3 (1)	—	—
9	1	1	1	—	1	1	1	1-2 (1)	1-2 (1)	—
10	1-3 (2)	—	—	1	1-2 (1)	1	1	1	1	—
11	1	—	—	1	1	1	1	1	1	—
12	1-2 (2)	—	—	—	—	1	—	—	—	—
14	—	—	—	1	1	1	1	1	1	1

¹ Range followed in parenthesis by the mode.

(1965) and preparing the specimens for study follow the procedures of Wood et al. (1979). A female of *Aedes cretinus* was collected in Athens, Greece, by A. Samanidou, blood fed and held in a 9-dram vial until it oviposited. Eggs were seasoned then hatched and larvae mass reared to the fourth instar, then several were reared individually. The larval and pupal exuviae were preserved and subsequently slide mounted in Canada balsam. Similarly, fourth instar larvae from a colony of *Ae. cretinus* at Notre Dame University, started from specimens collected on the island of Crete, were reared individually and made available for this study by C. Taafe.

The *Aedes albopictus* pupae were from two sources: Nepal-reared from larvae collected in bamboo stumps in Ranibas, Sinduli Garhi District, 1991 (4 ♀ and 6 ♂), and U.S.A.—individual rearings of larvae collected in Vero Beach, Florida, 1997 (9 ♀ and 1 ♂).

The *Ae. aegypti* pupae (8 ♀ and 14 ♂) were obtained from a colony at the Naval Medical Research Center, Bethesda, Maryland, provided by H. S. Hurlbut, 1947.

Abbreviations used in the description are: Le Pe = larval exuviae and pupal exuviae, and br = branches.

DESCRIPTION

Aedes (Stegomyia) cretinus Edwards (Fig. 1)

Pupa.—Position and size of setae as in Fig. 1; range and modal number of branches in Table 1. *Cephalothorax*: Seta 7-CT 1.29–2.2 length of 6-CT, both single; trumpet medium to dark brown, reticulate, length 0.46–0.65 mm, pinna 0.07–0.20 mm, index 1.46–1.73. *Abdomen*: light to medium brown, darker sublaterally; seta 1–II with 2–3 br from base; 6-VI single, rarely double, 0.7 length of 9-VII; 9-II not much smaller than 9-III–V; 9-V 0.8 length of 9-VI; 9-VI 0.3 length of 9-VII, subequal in size; 9-VII single, smooth, stouter than 5-VI; 9-VIII stout, single, rarely with 2 main stems, with several long aciculae near middle, about 0.2 length of seta. *Paddle*: Outer and inner margins fringed in apical 0.6, fringe length 0.05 mm, midrib extending to near apex, seta 1-P rather stout, single, 0.29–0.4 length of paddle.

Specimens examined.—The description was based on the following: Greece, Attiki District, Athens, Kifissa, IX-30-97, 2 ♀ Le, Pe, 4 ♂ Le, Pe; Crete, VII-93, 5 ♀, Le, Pe, and 7 ♂, Le, Pe. (L.E. Munstermann) (from

Table 2. Distinguishing characters of three *Stegomyia* species in Europe.

Character	<i>aegypti</i>	<i>albopictus</i>	<i>cretinus</i>
ADULT FEMALE			
Scutum	Lyre-shaped pale marking	Narrow pale stripe, no sub-median stripes	Narrow pale stripe, with sub-median stripes
Abdominal sterna III-V	Pale-scaled	Dark-scaled, basal pale bands	Dark-scaled, basal pale bands
Clypeus	With scales	No scales	No scales
Mesepimeron	2 scale patches	Single V-shaped scale patch	Single V-shaped scale patch
Fore- and mid-tarsomeres	Toothed	Simple	Toothed
PUPA			
Seta 7-CT/ seta 6-CT	7-CT 0.53-0.77 length of 6-CT	7-CT 1.25-2.7 length of 6-CT	7-CT 1.29-2.2 length of 6-CT
Seta I-II	2-4 br	4-8 br	2-3 br
Seta 9-VIII	3-8 br	1-2 br	1-2 br
Seta 9-VIII length	NA	Reaching beyond paddle fringe	Not reaching to paddle fringe
Paddle index	1.06-1.31	1.22-1.38	1.4-1.7
Paddle fringe	Absent	Present	Present
FOURTH INSTAR LARVA			
Seta 4-X, No. Pairs on grid	5 pairs	4 pairs	4 pairs
Branching of seta 4-X	Setae branched	Setae single	Mostly single some double
Comb scale	Prominent apical and sub-apical spines	Prominent apical spine, tiny basal spinules	Prominent apical spine, tiny basal spinules
Setal support plates—setae 9-I2-M, T	Prominent spine	Short thin spine	Small spine
Seta 7-C	Single	Double	2-3 br
Siphon index	2.5 or less	2.0 or less	2.4 or more

University of Notre Dame colony, C. Taafe).

KEY TO THE KNOWN PUPAE OF THE *ALBOPICTUS* SUBGROUP, *SCUTELLARIS* GROUP, SUBGENUS *STEGOMYIA*

In order to identify the pupa of *Ae. cretinus*, it is placed in the following key to the known pupae of the *albopictus* subgroup. The *Aedes unilineatus* (Theobald) pupa was incompletely described by Edwards (1941), therefore its placement in the key is tentative. The key was adapted from Huang (1972a).

- I. Seta 9-III-V strongly developed, thickened, much stouter than 9-II *seatoi* Huang
- Seta 9-III-V not strongly developed, about same magnitude as 9-II 2
- 2(1). Seta 9-VI much stouter than 9-V, at least twice as long 3
- Seta 9-VI about as thick as 9-V, less than twice as long 4
- 3(2) Seta 9-VI usually single, acuminate; seta 9-VIII reaching beyond paddle fringe. *downsi* Bohart and Ingram
- Seta 9-VI single, smooth; seta 9-VIII not reaching beyond paddle fringe *subalbopictus* Barraud
- 4(2). Seta 9-VII usually single, stout, acuminate or split at tip 5
- Seta 9-VII usually single, smooth 7
- 5(4). Paddle margins with rather short fringe; seta 9-VIII single, strong, acuminate, just reaching paddle fringe *novalbopictus* Barraud
- Paddle margin with long fringe; seta 9-VIII with 2 main stems (1-2), each acuminate, reaching beyond paddle fringe 6
- 6(5). Seta I-II with 8 or more branches; seta 1-P 0.5 length of paddle *flavopictus* Yamada

- Seta 1-II usually with fewer than 8 branches; seta 1-P 0.3 length of paddle
- *unilineatus* (Theobald)
- 7(4). Seta 9-VIII not reaching beyond fringe of paddle 8
- Seta 9-VIII reaching beyond fringe of paddle 9
- 8(7). Seta 1-II with 5-7 branches; seta 9-VIII usually double *patriciae* Mattingly
- Seta 1-II double or triple; seta 9-VIII usually single *cretinus* Edwards
- 9(7). Seta 9-VIII with 2 branches; seta 10-CT about 0.6 length of seta 11-CT; seta 2-VII medial to seta 1-VII *pseudalbopictus* (Borel)
- Seta 9-VIII usually single; seta 10-CT subequal to seta 11-CT; seta 2-VII laterad of seta 1-VII *albopictus* (Skuse)

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LITERATURE CITED

- Adhami, J. and N. Murati. 1987. Presence du moustique *Aedes albopictus* en Albanie. *Revista Mjeksore* 1: 1-16.
- Belkin, J. N., R. X. Schick, P. Galindo, and T. H. G. Aitken. 1965. Mosquito studies (Diptera, Culicidae) I. A project for a systematic study of the mosquitoes of Middle America. *Contributions of the American Entomological Institute* 1(2): 78 pp.
- Christophers, S. R. 1960. *Aedes aegypti* (L.) The yellow fever mosquito. Its life history, bionomics and structure. Cambridge University Press, London, 738 pp.
- Edwards, F. W. 1921. Revision of the mosquitoes of the Palearctic Region. *Bulletin of Entomological Research* 12: 263-351.
- Edwards, F. W. 1932. *Genera Insectorum. Diptera. Family Culicidae.* Fascicle 194, 258 pp., Belgium.
- . 1941. Mosquitoes of the Ethiopian Region. III.—Culicine adults and pupae. British Museum (Natural History), London, 499 pp.
- Huang, Y. M. 1969. A new species of *Aedes* (*Stegomyia*) from Thailand (Diptera: Culicidae). *Proceedings of the Entomological Society of Washington* 71: 234-239.
- . 1972a. Contributions to the mosquito fauna of Southeast Asia. XIV. The subgenus *Stegomyia* of *Aedes* in Southeast Asia. I.—The *scutellaris* group of species. *Contributions of the American Entomological Institute* 9(1): 1-109.
- . 1972b. Lectotype designation for *Aedes* (*Stegomyia*) *galloisi* Yamada with a note on its assignment to the *scutellaris* group of species (Diptera: Culicidae). *Proceedings of the Entomological Society of Washington* 74: 253-256.
- . 1979. Medical entomology studies—XI. The subgenus *Stegomyia* of *Aedes* in the Oriental Region with keys to the species (Diptera: Culicidae). *Contributions of the American Entomological Institute* 15(6): 1-79.
- Kinght, K. L. and H. S. Hurlbut. 1949. The mosquitoes of Ponape Island, eastern Carolinas. *Journal of the Washington Academy of Sciences* 39: 20-34.
- Lane, J. 1982. *Aedes* (*Stegomyia*) *cretinus* Edwards 1921 (Diptera: Culicidae). *Mosquito Systematics* 14: 81-85.
- Mattingly, P. F. 1952. The subgenus *Stegomyia* (Diptera: Culicidae) in the Ethiopian Region. (Part I). *Bulletin of the British Museum (Natural History) Entomology* 2: 235-304.
- . 1953. The subgenus *Stegomyia* (Diptera: Culicidae) in the Ethiopian Region (Part II). *Bulletin of the British Museum (Natural History) Entomology* 3: 1-65.
- . 1954. Notes on the subgenus *Stegomyia* (Diptera, Culicidae), with a description of a new species. *Annals of Tropical Medicine and Parasitology* 48: 259-270.
- . 1965. The culicine mosquitoes of the Indomalayan Area. Part VI. Genus *Aedes* Meigen, subgenus *Stegomyia* Theobald (Groups A, B, and D). *British Museum of Natural History*, 67 pp.
- Romi, R. 1995. History and updating on the spread of *Aedes albopictus* in Italy. *Parassitologia* 37: 99-103.
- Sabatini, A., V. Raineri, G. Trovato, and M. Coluzzi. 1990. *Aedes albopictus* in Italia e possibile diffusione del la specie nell'area mediterranea. *Parassitologia* 32: 301-304.
- Wood, D. M., P. T. Dang, and R. A. Ellis. 1979. The insects and arachnids of Canada Part 6. The mosquitoes of Canada. *Biosystematics Research Institute. Canada Department of Agriculture Publication* 1686. 390 pp.